Note the volume and head units must be in GPM and ft, respectively, to use this "rule of thumb" equation. Therefore units need not be shown, provided they are confirmed to be correct prior to use.

Recall that brake horsepower, bhp, depends on water horsepower, whp, and the efficiency of the pump, η_p. Similarly, the electrical power, $\dot{W}$,depends on brake horsepower, bhp, and motor efficiency, η_m.

$$bhp = \frac{whp}{\eta_p}$$

$$\dot{W} = \frac{bhp}{\eta_m}$$

Put these together, substitute, solve, and convert to KW:

$$\dot{W} = \frac{whp}{\eta_p \eta_m} = \frac{6.566hp}{(.8)(.93)} \left(\frac{.746KW}{1hp}\right) = 6.58KW$$

To find the annual cost, multiply by time and the unit rate of electricity:

$$Cost = (6.58KW)\left(\frac{12hrs}{day}\right)\left(\frac{5days}{wk}\right)\left(\frac{52wks}{yr}\right)\left(\frac{\$0.13}{KWH}\right) = \$2669\, per\, year$$

Answer A

46.7 A $7.5hp$ single phase $230V$ motor drawing $40A$ at full load is located $50\,meters$ from the voltage source. The motor is wired with $8AWG$ wire which has a cross sectional area of $16,509\,circular\,mils$ ($1\,circular\,mil = 5.066 \times 10^{-10} m^2$) and a resistivity of $1.724 \times 10^{-8}\Omega \cdot m$. What is the percent voltage drop for the wiring in the circuit?

A. 1%

B. 2%

C. 3%

D. 4%

The electrical resistance attributable to the wiring is the result of copper's resistivity, which is an intrinsic material property, and the length and gauge of the wire. The formula for resistivity can be rearranged to solve for the total resistance.

$$\rho = \frac{RA}{L}$$

$$R = \frac{\rho L}{A}$$

Since the motor is $50ft$ from the voltage source, a sufficient length of wire must be provided to make a round trip from the source to the load and back. Therefore, the total length is given by:

$$L = 2(50m) = 100m$$

Determine the resistance.

$$R = \frac{\rho L}{A} = \frac{\left(1.724 \times 10^{-8}\Omega \cdot m\right)(100m)}{(16,509cmil)\left(5.066 \times 10^{-10}\frac{m^2}{cmil}\right)} = 0.206\Omega$$

Find the voltage drop due to the wire by applying Ohm's Law.

$$V_{drop} = IR = (40A)(0.206\Omega) = 8.25V$$

Determine the percentage voltage drop by dividing by the nominal voltage of the source.

$$\frac{V_{drop}}{V_{source}} = \frac{8.25V}{230V} = 0.036 = 3.6\%$$

Answer D

46.8 $1000cfm$ of $350°F$, $80psia$ air is supplied by an air compressor. What is the standard volume flow rate (SCFM)?

A. $100cfm$

B. $300cfm$

C. $3500cfm$

D. $8500cfm$

Since the air being supplied is at an elevated temperature and pressure, it is necessary to make Temperature and Altitude Corrections for Air. This can be achieved using the factors in the table; however, the pressure is given in psia rather than as an elevation, therefore it is more straightforward to multiply by the ratio of the pressure as compared to standard atmosphereic pressure. Similarly, a temperature ratio multiplier is also convenient to use, provided absolute temperature units are used. Standard temperature and pressure may be considered $60°F$ and $14.7psia$.

In terms of qualitative expectations, a higher than standard pressure implies the standard CFM (SCFM) will be higher than the actual CFM. A higher than standard temperature implies the standard CFM will be lower than the actual CFM. In concept, SCFM is attempt to explain how much volume the compressor would move if pumping air at STP.

$$SCFM = (1000cfm)\left(\frac{80psia}{14.7psia}\right)\left(\frac{60°F + 460°R}{350°F + 460°R}\right) = 3,493cfm$$

Answer C